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September 25, 2003

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APPLICATION NUMBER: *60/400,232*
FILING DATE: *July 31, 2002*
RELATED PCT APPLICATION NUMBER: *PCT/US03/24116*

By Authority of the
COMMISSIONER OF PATENTS AND TRADEMARKS

H. L. Jackson

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PTO/SB/16 (10-01)
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PROVISIONAL APPLICATION FOR PATENT COVER SHEET

This is a request for filing a PROVISIONAL APPLICATION FOR PATENT under 37 CFR 1.53 (c).

Express Mail Label No.	EU140615362US	7-31-02

INVENTOR(S)

Given Name (first and middle [if any])	Family Name or Surname	Residence (City and either State or Foreign Country)
REBECCA L HAMDY	SMITH ELWAKIL	VIENNA, WEST VIRGINIA HOCKESSIN, DELAWARE

☐ *Additional Inventors are being named on the _____ separately numbered sheets attached hereto*

TITLE OF THE INVENTION (500 characters max)

DECORATIVE LAMINATED SAFETY GLASS UTILIZING A RIGID INTERLAYER

Direct all correspondence to: **CORRESPONDENCE ADDRESS**

☒ Customer Number **23906** → *23906*
OR *Type Customer Number Here* PATENT TRADEMARK OFFICE

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Country		Telephone		Fax	

ENCLOSED APPLICATION PARTS *(check all that apply)*

☒ Specification *Number of Pages* 7 ☐ CD(s), Number
☐ Drawing(s) *Number of Sheets* ☐ Other (specify)
☐ Application Data Sheet. See 37 CFR 1.76

METHOD OF PAYMENT OF FILING FEES FOR THIS PROVISIONAL APPLICATION FOR PATENT

☐ Applicant claims small entity status. See 37 CFR 1.27.
☐ A check or money order is enclosed to cover the filing fees
☒ The Commissioner is hereby authorized to charge filing fees or credit any overpayment to Deposit Account Number: **04-1928**
☐ Payment by credit card. Form PTO-2038 is attached.

FILING FEE AMOUNT ($): $160

The invention was made by an agency of the United States Government or under a contract with an agency of the United States Government.

☐ No.
☐ Yes, the name of the U.S. Government agency and the Government contract number are: _____.

Respectfully submitted, Date 07/31/02

SIGNATURE [signature]

TYPED or PRINTED NAME KEVIN S. DOBSON REGISTRATION NO. (if appropriate) 40,296

TELEPHONE 302-892-5526 Docket Number AD6899 USPRV

USE ONLY FOR FILING A PROVISIONAL APPLICATION FOR PATENT

This collection of information is required by 37 CFR 1.51. The information is used by the public to file (and by the PTO to process) a provisional application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 8 hours to complete, including gathering, preparing, and submitting the complete provisional application to the PTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, Washington, D.C., 20231. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Box Provisional Application, Assistant Commissioner for Patents, Washington, D.C. 20231.

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FEE TRANSMITTAL for FY 2002

Patent fees are subject to annual revision

☐ Applicant Claims small entity status. See 37 CFR 1.27

TOTAL AMOUNT OF PAYMENT ($) 160

Complete If Known	
Application Number	
Filing Date	JULY 31, 2002
First Named Inventor	REBECCA L. SMITH ET AL.
Examiner Name	
Group / Art Unit	
Attorney Docket No.	AD6899 USPRV

METHOD OF PAYMENT *(check all that apply)*

☐ Check ☐ Credit card ☐ Money Order ☐ Other ☐ None

☒ Deposit Account

Deposit Account Number: 04-1928

Deposit Account Name: E. I. du Pont de Nemours and Company

The Commissioner is authorized to: *(check all that apply)*

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FEE CALCULATION

1. BASIC FILING FEE

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description	Fee Paid
101	740	201	370	Utility filing fee	
106	330	206	165	Design filing fee	
107	510	207	255	Plant filing fee	
108	740	208	370	Reissue filing fee	
114	160	214	80	Provisional filing fee	160

SUBTOTAL (1) ($) 160

2. EXTRA CLAIM FEES

			Extra Claims		Fee from below	=	Fee Paid
Total Claims		-20	0	X	18	=	0
Independent Claims		-3	0	X	84	=	0
Multiple Dependent	☐			X	280	=	0

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description
103	18	203	9	Claims in excess of 20
102	84	202	42	Independent claims in excess of 3
104	280	204	140	Multiple dependent claim, if not paid
109	84	209	42	** Reissue independent claims over original patent
110	18	210	9	** Reissue claims in excess of 20 and over original patent

SUBTOTAL (2) ($) 0

**or number previously paid, if greater, For Reissues, see above

FEE CALCULATION (continued)

3. ADDITIONAL FEES

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description	Fee Paid
105	130	205	65	Surcharge - late filing fee or oath	
127	50	227	25	Surcharge - late provisional filing fee or cover sheet	
139	130	139	130	Non-English specification	
147	2,520	147	2,520	For filing a request for reexamination	
112	920*	112	920*	Requesting publication of SIR prior to Examiner action	
113	1,840*	113	1,840*	Requesting publication of SIR after Examiner action	
115	110	215	55	Extension for reply within first month	
116	400	216	200	Extension for reply within second month	
117	920	217	460	Extension for reply within third month	
118	1,440	218	720	Extension for reply within fourth month	
128	1,960	228	980	Extension for reply within fifth month	
119	320	219	160	Notice of Appeal	
120	320	220	160	Filing a brief in support of an appeal	
121	280	221	140	Request for oral hearing	
138	1,510	138	1,510	Petition to institute a public use proceeding	
140	110	240	55	Petition to revive – unavoidable	
141	1,280	241	640	Petition to revive – unintentional	
142	1,280	242	640	Utility issue fee (or reissue)	
143	460	243	230	Design issue fee	
144	620	244	310	Plant issue fee	
122	130	122	130	Petitions to the Commissioner	
123	50	123	50	Processing fee under 37 CFR 1.17(q)	
126	180	126	180	Submission of Information Disclosure Stmt	
581	40	581	40	Recording each patent assignment per property (times number of properties)	
146	740	246	370	Filing a submission after final rejection (37 CFR § 1.129(a))	
149	740	249	370	For each additional invention to be examined (37 CFR § 1.129(b))	
179	740	279	370	Request for Continued Examination (RCE)	
169	900	169	900	Request for expedited examination of a design application	

Other fee (specify) _____

*Reduced by Basic Filing Fee Paid SUBTOTAL (3) ($) 0

SUBMITTED BY				Complete *(if applicable)*	
Name (Print/Type)	KEVIN S. DOBSON	*Registration No. Attorney/Agent)*	40,296	*Telephone*	302-892-5526
Signature				*Date*	JULY 31, 2002

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AD6899 USPRV

TITLE

DECORATIVE LAMINATED SAFETY GLASS UTILIZING A RIGID INTERLAYER

BACKGROUND OF THE INVENTION

Laminated safety glass consists of two lites of glass joined by an energy absorbing plastic interlayer, typically polyvinyl butyral. Laminated safety glass is used in automotive windshields and in architectural building glass. Architects are continually using glass in more demanding applications such as balustrades, partitions, floors, doors, and overhead bolted glass. Laminated safety glass using PVB as the interlayer does not meet the strength or post glass breakage requirements for these applications. Ionomers of ethylene/methyacrylic acid copolymers (sold under the DuPont tradename Surlyn®) yield interlayer materials that are rigid, much stiffer and tougher than traditional PVB interlayers. Laminated safety glass utilizing these stiffer, tougher interlayers has been shown to possess the strength and post glass breakage requirements needed for these demanding architectural applications.

In addition, it has been found that interlayers of ionomeric ethylene/methyacrylic acid copolymers demonstrate much improved edge stability over traditional PVB interlayers. This improved edge stability allows for laminated glass (with interlayers of ionomeric ethylene/methyacrylic acid copolymers) to be used in applications such as shower doors and exterior open edge applications where traditional laminated glass (with PVB interlayers) would not be used. In many of these above-mentioned applications (balustrades, partitions, floors, doors, overhead bolted glass, and shower doors) it would be desirable to have a decorative image in the laminated safety glass.

Processes for making laminated decorative glass have been disclosed in WO 217154A1, DE 29706880, US 4968553, US 5914178, EP 1129844A1, and DE 20100717. These decorative laminates use PVB, PVB/PET/PVB composites, or EVA (ethylene/vinyl acetate copolymers) as the interlayer. While the resulting decorative safety glass laminate may meet the architectural safety codes, these laminates are not appropriate for applications such as those outlined above.

Further many of these references disclose a process for making decorative laminated glass via a silk screening process (DE 29706880, US

4968553, US 5914178, EP 1129844A1, and DE 20100717). Silk-screening an image onto an interlayer is a very time-consuming and expensive process for making decorative laminated safety glass. Ink jet technology is very flexible; any digital image can be printed onto the substrate. Using ink jet technology to print on flexible interlayers (PVB and polyurethanes) for laminated safety glass has been disclosed in WO 0218154. A disadvantage of ink jet printing directly on PVB is that all PVB interlayers have a roughened surface pattern (Rz from 30-60 □m), which is present to allow for air to escape during the lamination process as described in US 5455103. The rough surface pattern can effect image quality with respect to mottle and resolution.

Printing on an ionomer of ethylene/methyacrylic acid copolymer has not been described in the literature, however one problem that is readily apparent is that the stiffness of an ionomer of ethylene/methyacrylic acid copolymer is not amenable to any or all conventional printing processes. For example, ink jet printing as on a flexible interlayer material such as PVB is possible on a conventional printer because PVB is flexible enough to be run through the printer. However, ink jet printing on an ionomer of ethylene/methyacrylic acid copolymer on a conventional ink jet printer may be problematical because an ionomer of ethylene/methyacrylic acid copolymer is not flexible enough to be processed through conventional ink jet printers. Further, problems with printing on an ionomer of ethylene/methyacrylic acid copolymer can present themselves due to impermeability of conventional inks on the an ionomer of ethylene/methyacrylic acid copolymer surface.

SUMMARY OF THE INVENTION

In one aspect, the present invention is a system for "ink jet" printing on rigid ionomeric ethylene/methyacrylic acid copolymers interlayers in such a way that when laminated between 2 lites, the laminate maintains its strength and post glass breakage requirements.

In another aspect, the present invention is a decorative glass laminate comprising at least two sheets of glass having disposed therebetween an interlayer comprising an ionomer of ethylene/methyacrylic acid copolymer, wherein the ionomer interlayer comprises a printed image on at least one of the interlayer surfaces, and wherein at least one of the printed surfaces is adhered to one of the glass surfaces.

In still another aspect, the present invention is a decorative glass laminate comprising at least two sheets of glass having disposed therebetween an interlayer comprising an ionomer of ethylene/methyacrylic acid copolymer, wherein the ionomer interlayer comprises a printed image on at least one of the interlayer surfaces, and wherein at least one of the printed surfaces is adhered to one of the glass surfaces, and wherein the image has been printed on the interlayer surface using an "ink jet" printer.

DETAILED DESCRIPTION OF THE INVENTION

In one embodiment, this invention is a method for printing a decorative image on a rigid interlayer by printing with either an aqueous or solvent based ink by using ink jet printing technology and laminating the image carrying layer between two lites of glass or other material.

In a preferred embodiment, the image is printed onto the interlayer using an inkjet printer equipped with a piezoelectric drop on demand printhead such as Spectra or Xaar and the inkjet printer is chosen so that the rigid interlayer is held on a bed type support. The interlayer is an ionomer of an ethylene/methacrylic acid copolymer where the surface roughness (Rz) of the sheet is between 5 and 15 μm and the interlayer thickness is between 0.38-2.29 mm.

Interlayers based upon ionomeric ethylene/methyacrylic acid copolymers are extremely rigid and stiff. This extremely high stiffness allows for a much smoother surface pattern (Rz for PVB is 30-60 μm; Rz for stiff interlayers is from 5 to 15 μm) to be used to obtain acceptable deairing since for the stiff interlayer the surface pattern does not break down as rapidly during the deairing step in the lamination process. The smooth surface pattern for the ionomeric interlayer yields printed images with higher resolution and less mottle than images printed directly on PVB.

In another embodiment, this invention is a laminate containing a decorative image, which is printed on an interlayer of ionomeric ethylene/methyacrylic acid copolymers. The laminate has good adhesion between the image carrying layer and the lites of glass or other material and can be used in any application where standard laminated glass is needed as well as in applications where the laminate will be held in a 1, 2, or 3 sided support (balustrade, partition wall, overhead bolted glass, etc.).

In still another embodiment, the ink formulation contains a binder resin to improve adhesion between the ink and either the second unprinted layer or the

glass lite. The binder resin can be selected from a list including, but not limited to, polyvinyl pyrrolidone, polyvinyl pyrrolidone/vinyl acetate, and polyurethane.

In yet another embodiment, this invention comprises a second interlayer sheet placed between the primary image carrying layer and the lite of glass. This second layer may be a clear, unprinted layer, or carry a printed image or be any solid, translucent color (e.g., white). The second layer can be any material that gives the desirable adhesion to glass, such as polyurethane, polyester, or polyvinylbutyral, for example.

EXAMPLES

The following examples are presented to illustrate the invention. The examples are not intended to limit the scope of the invention in any manner.

Test Methods

Surface Roughness, Rz, is determined from the 10 point average roughness as described in ISO-R468 and is expressed in microns. Surface roughness is measured using a Mahr Federal (Providence, RI) surfanalyzer.

Laminate adhesion is determined by a modified pummel adhesion test. In the standard pummel adhesion test, the laminate is conditioned to -18°C for a minimum of 3 hours. In the modified pummel adhesion test, the laminate is held at 22°C for 3 hours. After conditioning, the laminate is held at a 45° angle on a metal plate and struck with a 227 g (0.5 lb) hammer until the glass was broken. The samples are then graded by comparing the amount of glass retained on the laminate to a set of standards (from Solutia, St. Louis, MO). The grading scale ranges from 0 (0% of glass retained on the laminate) to 10 (100% of glass retained on the laminate).

Adhesion between the interlayer film with the decorative image printed on the surface and another clear layer of interlayer film was determined by measuring the force required to separate the two layers using an Instron in compression mode. For this experiment, a laminate is made with the following construction: glass/coated Mylar®/clear interlayer/printed interlayer/coated Mylar®/glass. Prior to autoclaving, along one edge in between the two interlayer sheets, 2 small pieces of uncoated Mylar® (7 mil thick each) are placed so they extend 6 mm into the laminate and extend 3 mm out of the laminate. After autoclaving, the glass and outer Mylar® layers are removed to leave the 2 interlayer sheets adhered with the 2 small pieces of Mylar® along one edge (which creates a small gap in between the 2 layers). The interlayer sheets are

then clamped into a frame and a wedge is inserted into an Instron. Using the Instron in compression mode, the wedge is lowered into the gap created by the Mylar®. The force is measured to force the 2 interlayer sheets apart.

CLAIMS

What is claimed is:

1. A system for "ink jet" printing on rigid ionomeric ethylene/methyacrylic acid copolymers interlayers in such a way that when laminated between 2 lites, the laminate maintains its strength and post glass breakage requirements.

2. A decorative glass laminate comprising at least two sheets of glass having disposed therebetween an interlayer comprising an ionomer of ethylene/methyacrylic acid copolymer, wherein the ionomer interlayer comprises a printed image on at least one of the interlayer surfaces, and wherein at least one of the printed surfaces is adhered to one of the glass surfaces.

3. A decorative glass laminate comprising at least two sheets of glass having disposed therebetween an interlayer comprising an ionomer of ethylene/methyacrylic acid copolymer, wherein the ionomer interlayer comprises a printed image on at least one of the interlayer surfaces, and wherein at least one of the printed surfaces is adhered to one of the glass surfaces, and wherein the image has been printed on the interlayer surface using an "ink jet" printer.

TITLE

DECORATIVE LAMINATED SAFETY GLASS UTILIZING A RIGID INTERLAYER

ABSTRACT OF THE DISCLOSURE

The present invention is a decorative glass laminate comprising at least two sheets of glass having disposed therebetween an interlayer comprising an ionomer of ethylene/methyacrylic acid copolymer, wherein the ionomer interlayer comprises a printed image on at least one of the interlayer surfaces, and a process for preparing same.